The global burden of disease in 1990: summary results, sensitivity analysis and future directions

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A basic requirement for evaluating the cost-effectiveness of health interventions is a comprehensive assessment of the amount of ill health (premature death and disability) attributable to specific diseases and injuries. A new indicator, the number of disability-adjusted life years (DALYs), was developed to assess the burden of disease and injury in 1990 for over 100 causes by age, sex and region. The DALY concept provides an integrative, comprehensive methodology to capture the entire amount of ill health which will, on average, be incurred during one's lifetime because of new cases of disease and injury in 1990. It differs in many respects from previous attempts at global and regional health situation assessment which have typically been much less comprehensive in scope, less detailed, and limited to a handful of causes.

This paper summarizes the DALY estimates for 1990 by cause, age, sex and region. For the first time, those responsible for deciding priorities in the health sector have access to a disaggregated set of estimates which, in addition to facilitating cost-effectiveness analysis, can be used to monitor global and regional health progress for over a hundred conditions. The paper also shows how the estimates depend on particular values of the parameters involved in the calculation.

Introduction

Three perceived needs of the international public health information system motivated the design and implementation of the Global Burden of Disease (GBD) study reported here, which was undertaken collaboratively by WHO and the World Bank as background for the World Bank's *World development report 1993: investing in health* (*1*). The first is that if, ten years ago, one had summed the various estimates of mortality, by cause, for children and adults, they would have equalled several times the total deaths at each age. Through the efforts of the World Health Organization, stimulated in part by the World Bank's health sector priorities review, the estimates for deaths by cause under age 5 have been rationalized (*2*). Through a consultative process, the estimates for major causes of child mortality generated by WHO technical programmes now add up to the total mortality. For adults, however, a consistent set of estimates of mortality by cause did not exist prior to this study. Furthermore, claims about adult mortality by various disease advocates have not been scrutinized. The most detailed review of adult health, the World Bank's study on adult health in developing countries (*3*), indicated the weakness of measurements of adult mortality levels and causes. Providing a plausible, internally consistent, set of estimates of mortality by cause was an important goal for this exercise.

Second, most discussions of international public health priorities ignore issues of disability. For some, disability is considered only a problem for societies that have already undergone the epidemiological transition and where mortality rates are low. Considerable efforts have been made in recent years to measure disability, both by the United Nations and through national research projects (*4–13*). While these works are important advances in the measurement of disability, they have not much influenced the debate on health priorities—in large part because the burden of disability by cause or that part of it which is amenable to specific health interventions has not been measured. Estimating the amount of life lived with a disability and its relative significance vis-à-vis premature mortality by cause was thus a second major goal of the study.

Third, too often health planners or decision-makers are faced with a multitude of health problems and priorities for action. The disease or health problem with the most vocal or eloquent advocates often

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garners the most attention. Some problems, however, do not have ready advocates and continue to be ignored. A major justification for the Global Burden of Disease study was to provide a process through which every disease or health problem would be evaluated in an objective fashion. The third goal was thus to provide a framework for objectively identifying epidemiological priorities, which together with information on the cost-effectiveness of interventions can help when decisions on the allocation of resources have to be made.

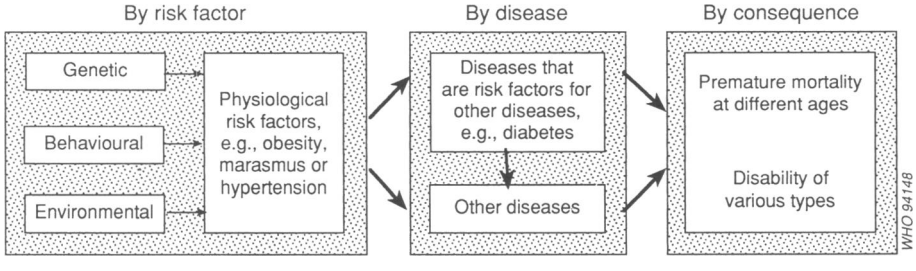
This paper is one of four in this issue of the *Bulletin of the World Health Organization* on the Global Burden of Disease study (*14–16*). Through the study, a new measure, the disability-adjusted life year (DALY), was developed and applied to estimating the burden of disease for more than 100 causes, for five age groups and the two sexes in eight regions of the world. The technical details of the strategy used to measure the time lived with a disability in a manner that can be meaningfully compared with the time lost because of premature mortality are provided in Murray (*14*). The methods, materials and results for the measurement of deaths by cause and disability by cause are provided elsewhere (*15, 16*). This article presents the main results, explores the sensitivity of the results to various assumptions, and proposes future directions for research.

Combined indicators of health or disease burden have a long history dating back to the mid-sixties. Only one attempt to measure the burden of disease in a comprehensive manner, however, was made before this study. The Ghana health assessment project team estimated the burden of disease due to mortality and morbidity in Ghana for 48 causes (*17*). In scope, their study is a landmark effort. The definition, measurement and weighting of disability were not, however, provided in detail or explained. Although its results were widely cited, the enormous effort undertaken in Ghana was not followed by applications of the same method in other countries or even subsequently in Ghana itself. The consequent lack of interest in quantifying or monitoring the burden of disease may have been due to several factors including the extensive data requirements, the need for specific assumptions on the treatment of disability, and the lack of a direct channel into decision-making. With the expanding role of cost-effectiveness in planning the health sector, the need for a more comprehensive measurement of the burden of disease has become more apparent and urgent (*18*).

In 1987 the World Bank initiated a major analytical public health initiative, the Health Sector Priorities Review. This exercise, culminating in the publication of Disease Control Priorities for Developing Countries (*19*), has documented existing knowledge about the cost-effectiveness of health interventions in developing countries. With comparable information on the cost-effectiveness of nearly 50 interventions, interest in the allocative efficiency of the health sector has increased. The broadening analytical role for cost-effectiveness laid the foundation for the health policy message in the world development report for 1993 (*1*). In order to use cost-effectiveness to develop an essential package of health services, it is useful to know the burden of disease (*18*). The quantification reported here of the global and regional disease and injury burden to be addressed by the health services was thus a critical input to the World Development Report. The study has received financial and technical support from the World Bank, WHO, the Edna McConnell Clark Foundation, the Rockefeller Foundation, and the U.S. Centers for Disease Control and Prevention.

The assessment of disease burden reported here represents one major step in a larger programme of work that is further discussed in the concluding section of this paper. Fig. 1 illustrates that programme schematically; the burden of disease can be grouped in three separate ways for different age, sex and regional groupings of population. One group is by *risk-factor*—genetic, behavioural, environmental and physiological. The second is by *disease*. The third is by consequence—*premature mortality* at different

Fig. 1. **Three categories of the burden of disease.**



ages and different *types of disability* (e.g., sensory, cognitive functioning, sensor functioning, affective state, etc.). The analyses reported in this series of articles deal principally with the second group, by disease. Consequences are aggregated simply into premature mortality and disability; a fuller assessment of burden by consequence would provide highly relevant information to guide rehabilitation programmes. Likewise a decomposition of burden by risk factor would better guide primary prevention. This assessment of burden, by disease, is a precursor to the other groups while also providing a broad sense of disease burden to guide intervention.

Methods

Details of the methods, approaches and principles used to estimate causes of death by age, sex and region and the methods used for measuring disability incidence, duration, and severity have been described (*15, 16*). The study used a regional breakdown into two sets of regions: demographically developing countries—Sub-Saharan Africa (SSA), India (IND), China (CHI), Other Asia and Islands (OAI), Latin America and the Caribbean (LAC), and the Middle Eastern Crescent (MEC)—and two region with demographically mature populations, the Established Market Economies (EME) and the Formerly Socialist Economies of Europe (FSE).

The study began in January 1992 with the Version 1 results which were presented and discussed at an expert group meeting hosted by WHO in Geneva in December 1992. Version 2 results reflecting widespread technical review were produced in February 1993. Following a more intensive and critical appraisal of the assumptions about disability and the disabling sequelae of diseases and injuries by an independent group of experts, Version 3 results were prepared in April 1993 and are presented in the world development report (*1*). This paper provides Version 4 results incorporating further technical review and a relatively minor revision of specific disease estimates. In a short period of time (i.e., less than 18 months), more than 100 experts were recruited to assist in the study, estimates were generated and widely reviewed, and the final results calculated and interpreted. The exercise would not have succeeded without tremendous assistance from the technical experts, the support of the World Health Organization, and the active input of our Advisory Committee.[a]

[a] The Global Burden of Disease Advisory Committee met in Geneva at the World Health Organization on 9–11 December 1992. The committee consisted of Dr J.-P. Jardel (*Chairman*), Professor R. Feachem, Dr T. Godal, Mr D. Jamison, Dr J. Koplan, Dr A. Measham, Dr J.-M. Robine, and Professor P. Smith.

Results

Combining the contribution from both premature mortality and the years of life lived with a disability, where was the greatest burden of disease in 1990? As Fig. 2 shows, Sub-Saharan Africa and India were the two regions with the largest contribution (21.5% each) to the global total. The significant health gains recorded in China are reflected in the 15% contribution from this country, compared with a 21.5% share of the world's population. The two regions, EME and FSE, which have recorded most success in reducing Group I disease (communicable, maternal and perinatal causes), together account for only about 11% of the global burden of disease, but have about twice that share of the global population. Nearly 90% of the global burden of disease in 1990 therefore occurred because of disease and injury in the developing world. When population size is taken into account (see Fig. 3), the comparatively poor health profile of Sub-Saharan Africa is even more apparent. For every 1000 people living in the region about 580 DALYs were incurred in 1990, compared with just over 100 in EME. Much of the burden of disease (about 75%) in Sub-Saharan Africa is due to premature mortality, as it is (but to a lesser extent) in India, MEC and OAI. In the four remaining regions, where the overall level of the burden of disease is lowest, the contribution from disability and premature death is roughly the same. The rate of DALYs is similar in China and FSE (as is life expectancy), being about 50% higher than in the EME region. Most of the difference between regions is due to differences in premature mortality while disability rates are more equal across regions. It is worth noting, however, that crude disability DALY rates are higher in poor developing regions than in the Established Market Economies.

The sex ratio (male/female) of DALY rates is shown in Fig. 4 divided into the components due to

Fig. 2. **Total DALYs, by region, as a percentage of global DALYs.**

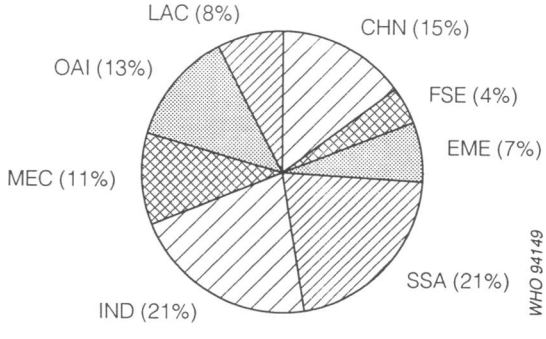


Fig. 3. **Total DALY rates, by region.**

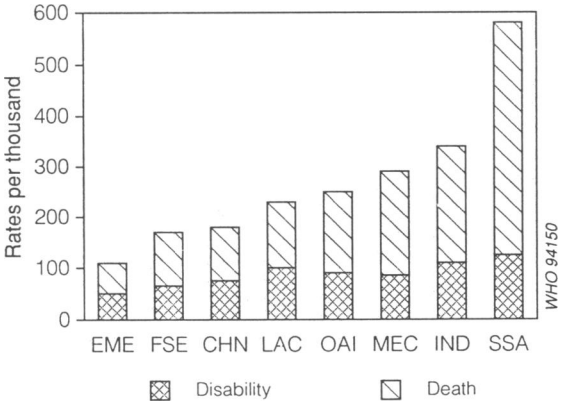
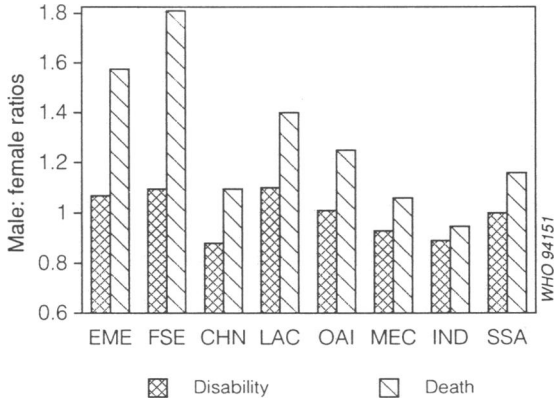


Fig. 4. **Male to female ratios of DALY rates for death and disability.**



disability and premature death. DALYs due to years of life lived with a disability are indicated by YLD and the years of life lost due to premature mortality by YLL. It is immediately apparent that the rate of YLD is similar for both sexes in all regions, with male rates being 5–10% higher in EME, FSE, and LAC, and 5–15% lower in CHI, MEC and India, compared with the female rates. In OAI and SSA the disability rates, as measured by YLD, are identical for both males and females. This relative uniformity in disability levels for the sexes contrast sharply with the very marked variation across regions in the differential mortality of the sexes. In EME, and particularly in FSE, males rates of YLL are 60–80% higher than for females and are 40% higher in LAC. In FSE and LAC this excess male mortality, particularly in middle age, is due to higher death rates from chronic diseases, which in turn are significantly affected by smoking. As female smoking prevalence continues to rise and the male epidemic stabilizes we expect that the sex mortality ratio in these two regions will begin to decrease, as it has begun to do so in some countries (*20*). Much of the excess male mortality in LAC, as captured by the YLL rates, is due to extremely high male death rates from injuries. The burden of premature mortality is similar for males and females in MEC and China, and is estimated to be higher for females in India, which is consistent with other research showing excess female mortality during childhood and the reproductive years.[b]

More details on the relative contribution of each age group to the total DALYs estimated for each region are given in Table 1. Overall, the burden of disease is greater among males in all regions except India (where it is shared equally between the sexes), with the male share of the total ranging from 51% in MEC and China to 57% in FSE. The age pattern of contributions varies markedly from one region to another, however. In EME, the region with the lowest DALY rate, the greatest contribution (21% each for both males and females) arises from diseases and injuries among the elderly. Only about 10% of the burden (half in males, half in females) is due to conditions affecting children below age 15. About 30% of all DALYs in both EME and FSE are attributable to the young adult ages (15–44 years), a pattern which is repeated across all regions. Even in Sub-Saharan Africa, one-quarter of the total burden of disease and injury arises from this age group, second in importance only to the massive contribution (53%) from diseases and injuries affecting young children.

The broad pattern of cause-specific contributions to total DALY rates during childhood (0–14 years), adulthood (15–59 years) and old age (60+) is given in Fig. 5 (females) and Fig. 6 (males). The pattern of regional variation is similar to what was observed for risks of death. At ages 0–14, much of the difference in DALY rates is due to differences in childhood risks of Group I diseases (communicable, maternal and perinatal), although even at these ages the contribution from Group II (noncommunicable disease) is significant, owing in large part to nutritional deficiencies and congenital abnormalities. Similarly, among women at least, almost all of the variation in DALY rates at ages 15–59 is due to differential rates of DALYs from Group I diseases across regions, being particularly high in Sub-Saharan Africa. A very different pattern emerges for men,

[b] **Dyson T.** *Excess female mortality in India: uncertain evidence on a narrowing differential.* Paper presented at the Workshop on Differential Female Health Care and Mortality, Dhaka, January 1987.

Table 1: **Percentage distribution of total DALYs, by age and sex, for each region**

Sex and age group (years)	Established Market Economies	Formerly Socialist Economies	China	Latin America and the Caribbean	Other Asia and Islands	Middle Eastern Crescent	India	Sub-Saharan Africa	All regions
Males:	56	58	51	56	54	51	50	52	52
0–4	4	5	12	18	21	26	23	29	20
5–14	1	2	4	6	8	6	5	7	6
15–44	17	20	16	20	14	10	11	12	14
45–59	12	16	9	6	6	4	6	3	6
60+	21	15	11	5	5	4	5	2	7
Females:	44	42	49	44	46	49	50	48	48
0–4	3	4	13	14	17	25	24	25	19
5–14	1	1	4	5	7	6	6	6	5
15–44	12	11	16	15	13	11	12	12	13
45–59	8	8	6	5	4	3	4	2	4
60+	21	18	10	5	5	4	5	2	7

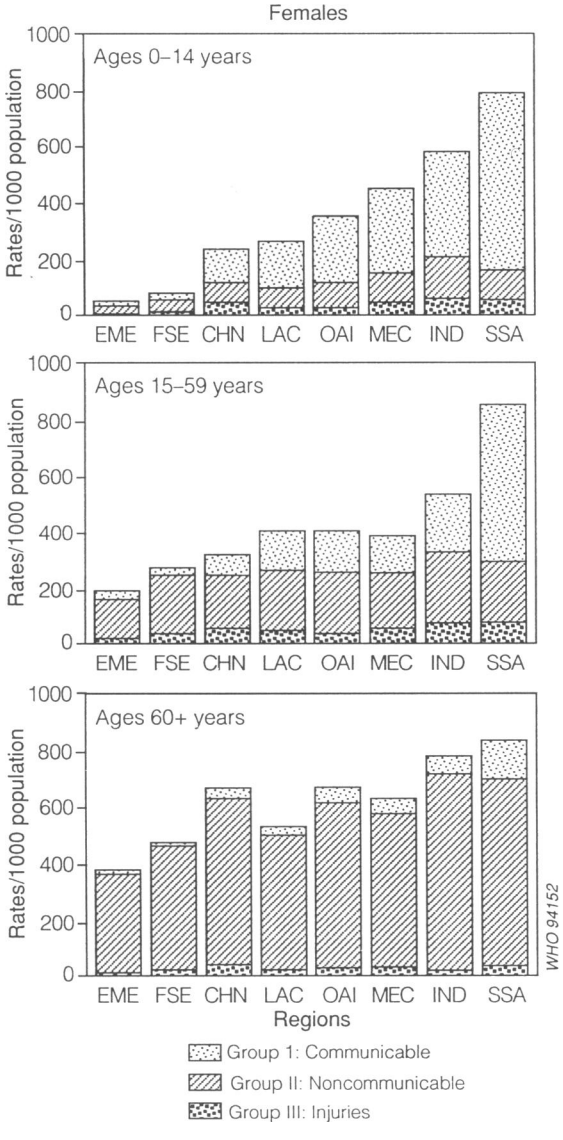
however. Total DALY rates in FSE and LAC are significantly higher than in all other regions except India and SSA. In FSE, this reflects the prominence of noncommunicable diseases, as well as injuries, as major public health concerns among men. The higher rates in LAC, compared with China or MEC for example, arise from a high injury-attributable burden, as well as a significant residual burden of noncommunicable disease even at these ages. DALY rates in Sub-Saharan Africa, half of which arise from Group I diseases, are also about twice as high as in most other regions of the developing world. There is thus a very major unfinished agenda in Africa in the conquest of infectious disease, which affects adults almost as much as young children. In the oldest age group (60+), the variation between developed and developing regions is still substantial, with women having twice as high DALY rates in SSA as in EME. Most of the difference is due to lower DALY rates of noncommunicable diseases in the developed regions. For men over 60, there are still higher rates in SSA as compared to EME but the excess is less pronounced than that for women.

Finally, a detailed summary of DALY numbers by age, sex and cause is given in the Annex (Tables 1, 2 and 3 for developed regions, developing regions and all regions, respectively, in 1990). The top half of each Table gives the absolute number of DALYs for the first level of cause disaggregation below the three large groups. The lower half of the Table gives the percentage of total DALYs within each age and sex group due to the next level of more specific causes. For each broad region, the list of specific causes has been chosen to include the top three causes in each age and sex group. Perhaps somewhat surprisingly, the burden of disease from noncommunicable diseases is virtually the same as for communicable diseases for the world as a whole, although there are of course significant regional variations. Cardiovascular disease, neuropsychiatric disorders, cancers and nutritional/endocrine disorders are globally major health problems, as are injuries. These causes combined accounted for over 40% of the global burden of disease in 1990. At the same time, the major infectious diseases which have dominated public health for centuries remain as significant causes of the disease burden today and must continue to be a principal focus of public health attention. These include tuberculosis (3.4% of the global burden), diarrhoeal diseases (7.3%), the vaccine-preventable diseases (5.0%) and acute respiratory infections (8.4%). In the developing world, 50% of DALYs are attributable to Group I causes, the usual focus of international public health interest. Half the burden in the developing world is due to noncommunicable diseases and injuries. Important among the Group II causes are neoplasms (4.4%), nutritional/endocrine disorders (4.2%), neuropsychiatric illness (6%), cardiovascular disease (9%), chronic respiratory diseases (3.4%), digestive disorders (3.2%), and congenital abnormalities (3.1%). Among injuries, two-thirds of the burden is due to unintentional and one-third to intentional, with considerable regional diversity in the specific pattern of deaths from injury.

Sensitivity analysis

Quite apart from the numerous judgements required concerning the reliability, relevance and applicability of data and information about mortality and disabili-

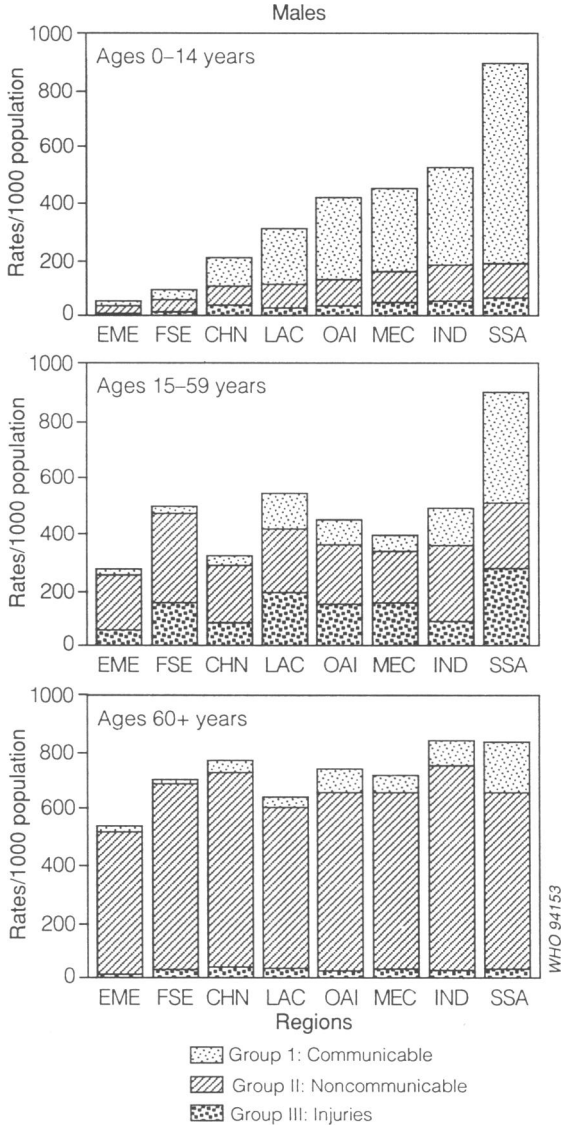
Fig. 5. **Total DALY rates for females within broad age ranges, by region, 1990.**



ty, the disability-adjusted life years incorporate some fundamental social values into its computation. We have tested the sensitivity of the results of the global burden of disease study to the most controversial of these assumptions, namely a positive discount rate and unequal valuation of the time lived at different ages. As described below, the sensitivity of the results to changing both discounting and age-weighting simultaneously has also been examined.

The discount rate (r) used in the calculation of DALYs has been varied from 0% to 10% in increments of 2.5%. To measure sensitivity of the results to the use of unequal age-weights, a new parameter must be introduced. The simple exponential age-weighting function in the original DALY formula

Fig. 6. **Total DALY rates for males within broad age ranges, by region, 1990.**



(see ref. *14* for discussion) has been replaced with the following function:

$$KCxe^{-\beta x} + (1 - K)$$

where K is an age-weighting constant. When K equals one, then the age-weighting function is the same as in DALYs; whereas when K equals zero, then the age-weights are equal. Fig. 7 demonstrates the age-weighting for several values of K between zero and one.

The entire global burden of disease by cause, age, sex and region has been recalculated 25 times for each combination of discount rates at 0%, 2.5%, 5%, 7.5%, and 10% and K values of 0, 0.25, 0.5, 0.75 and 1. Of the 1.25 million figures generated, only a few can be discussed here. In the following discussion, the emphasis is on the qualitative impact of changing r and K on the final results.

Variations in r and K have little or no effect on the difference between sexes in total DALYs. At the global level, the proportion for males ranged from 51% to 52% and even within regions the largest variation was in FSE, only from 52% to 59%. While change in the discount rate has little effect on the male/female difference in total DALYs, it has a much greater effect on the distribution of total DALYs by the age of onset. For whatever value of K, increasing the discount rate will decrease the proportion of total burden in the age groups 0–4 and 5–14 years, and increase the share in the adult age group (45–59 years) and the elderly (60+ years). Fig. 8 illustrates the effects on ages 0–4 and 15–44 years; 15–44 is the transition age group where changing the discount rate has only a small effect on the share of total DALYs. Shifting from equal to unequal age-weights by increasing K from 0 to 1 has a much smaller and more complex effect on the age distribution of total DALYs. Up to a discount rate of 5%, unequal age-weights increase the burden at ages less than 45 years. For example, if we compare DALYs calculated with r=3% and K=1, the original formula, and a 'classical' version with a discount rate of zero and equal age-weights, the difference in age distribution of total DALYs is small since some of the effect of a 3% discount rate is counterbalanced by the unequal age weights. At high discount rates, raising K reinforces the effect of discounting on the age pattern.

Because the cause structure of burden is different at different age groups, changing the discount rate and age-weighting changes not only the overall age pattern of DALYs but also the relative importance of premature mortality and disability and different causes. Table 2 shows the proportion of burden due to disability which ranges from 25% to 45%, with the lowest proportion due to disability when the discount rate is zero and age-weights are equal, and the

Fig. 7. **Age-weight function at different values of *K*.**

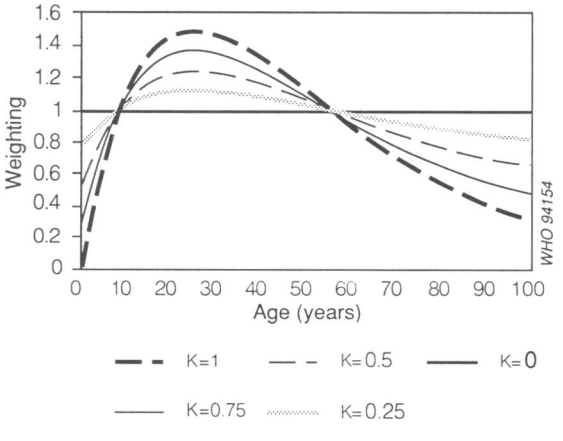


Fig. 8. **Global burden of disease sensitivity results: proportion of total DALYs in age groups of 0–4 years and 15–59 years.**

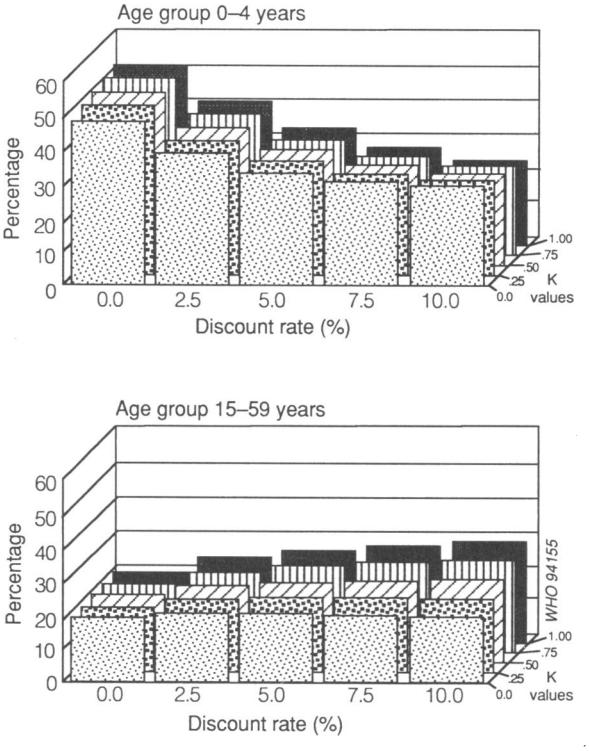


Table 2: **Years lived with a disability (YLD) as a percent of total DALYs at different *K* and *r* values (world total)**

	% YLD at *K* value of:				
r value (%)	0.00	0.25	0.50	0.75	1.00
0.0	25	26	26	27	29
2.5	33	33	33	33	33
5.0	37	38	38	38	38
7.5	41	41	41	41	41
10.0	45	44	44	44	45

highest when the discount rate is 10% and there is unequal age-weighting. As with the age pattern of total DALYs, changing the discount rate has a much larger effect than changing *K*. In fact, *K* has subtle qualitative effects depending on the level of the discount rate used.

Perhaps, the most important aspects of changing *r* and *K* to the study is the impact on DALYs by cause. Table 3 shows the proportion of the global burden due to Group I, Group II and Group III for different values of the discount rate and age-weighting patterns. Increasing the discount rate raises the importance of diseases affecting adults aged 15–59 and subsequently increases the share of Group II and decreases the share of Group I. Because Group III affects all age groups, changing the discount rate has a much less important effect on the share of total DALYs due to causes in this group. Shifting from equal to unequal age-weights by going from K=0 to K=1 has nearly the opposite effect from increasing the discount rate on Groups I and II but little effect on Group III.

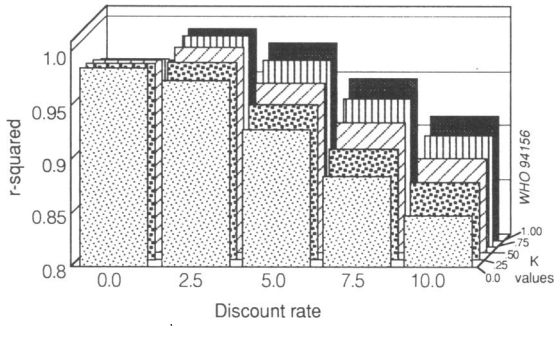
Table 3: **The percent distribution of DALYs for the three cause groups at different *K* and *r* values (global total)**

	% DALYs at *K* value of:				
r value (%)	0.00	0.25	0.50	0.75	1.00
Group I					
0.0	51	51	52	53	53
2.5	43	44	45	46	47
5.0	39	39	40	41	42
7.5	36	37	37	38	39
10.0	35	35	36	36	37
Group II					
0.0	37	37	36	35	34
2.5	46	45	44	42	41
5.0	51	50	49	47	46
7.5	54	53	52	51	50
10.0	57	55	54	53	52
Group III					
0.0	12	12	12	12	13
2.5	11	11	12	12	12
5.0	10	11	11	12	12
7.5	10	10	11	11	12
10.0	9	9	10	11	11

To test for the effect of changing *r* and *K* on the more detailed results by cause, the total DALYs due to each cause in each region and globally, calculated using different pairs of *r* and *K*, have each been regressed on the original results. The similarity of the cause-specific results with the GBD results can be measured using the *r*-squared from such regressions. In this case, the *r*-squared is a measure of how much of the variance in the burden of disease results, recalculated using a new set of assumptions, is captured in the original results. The Group I, II and III totals have been excluded because these spuriously raise the *r*-squared in the regressions. An *r*-squared of 1.0 would be a perfect match and an *r*-squared of 0.0 would mean there was no relationship between the two sets of estimates. Fig. 9 shows that at the global level, the *r*-squared ranges from 0.84 when r=10%, K=0 to 0.99 when r= 2.5%, K=1. When *r* is non-zero, then increasing *K* makes the results closer to the original study whereas when the discount rate is zero, increasing *K* has the reverse effect.

The two extremes—a 'classical' approach when r=0 and K=0 and a 'development economist' approach where r=10% and K=1—can be compared. The GBD results are closer (*r*-squared of 0.98) to the 'classical' assumptions than to the 'development economist' assumptions (*r*-squared of 0.91). The results even for these two extremes are surprisingly similar. Nearly the entire effect of changing *r* or *K* is due to the effect on shifting the age pattern and thus the Group I versus Group II balance. The same regressions conducted on the results within each Group all give *r*-squared estimates between 0.97 and

Fig. 9. **Global burden of disease sensitivity results: *r*-squared from regressions of cause-specific DALYs compared with the study results.**



1.0 for Group I, 0.94 to 0.98 for Group II, and 0.99 to 1.0 for Group III.

This summary analysis of the sensitivity testing suggests several conclusions. First, discounting has a significant impact on the distribution of total DALYs by the age of onset. Second, unequal age-weighting has a much less pronounced effect than discounting and an effect that often runs counter to the effect of a time preference. Third, the overall impact of both discounting and age-weighting on the calculated burden due to specific causes is small. We conclude that the qualitative results of the burden of disease analysis are quite robust to the specific assumptions about time preference and age-weighting used. While we do not present in this paper a detailed analysis, we have also tested the results to changing the specific values of the disability class weights. At the aggregate level, these changes have little if any effect on the overall results as presented here.

Discussion

The sensitivity analysis has shown that the qualitative results of the Global Burden of Disease study are remarkably insensitive to the particular social preferences incorporated into the calculation of DALYs. The largest effect of changing the discount rate or age-weights is on the age distribution of DALYs. More importantly, the estimates for burden by cause do not change appreciably over a wide range of discount rates and age-weights. The most important choice is whether to use a zero or non-zero time preference. Specific values of a non-zero discount rate (between 0 and 10 percent) make much less difference and the same is true for equal or unequal age-weights. Further sensitivity analysis of changing the disability weights on high-prevalence, low-severity conditions will be useful. Nevertheless, we are reassured that specific value choices matter much less than the epidemiological details for any particular condition.

The global burden of disease results presented here are built upon more than 50 000 estimates of mortality, incidence, age of onset, duration and severity by cause, age, sex and region. The confidence intervals for some, such as deaths in EME, are likely narrow but for other estimates, such as the incidence of HIV infections in OAI, they are probably very wide. Nevertheless, we feel the results are interesting, informative and potentially useful. These estimates should be seen as a first tentative step in a process. Continued application of the process described in these papers will lead to improved estimates and more robust results. Where diseases appear to be significant contributors to the burden and estimates are uncertain, we hope that the study will stimulate further work on local or regional epidemiology. The Tables of results must not be used as definitive and are not a substitute for future efforts to improve measurement.

How should these results and future versions of them be used to improve health policy decisions? Immediately, one can note the tremendous mismatch between international efforts on research and health policy analysis and the burden of disease by cause. Many of the major causes of burden in developing countries, as identified by this study, receive grossly disproportionate attention in international public health forums. For example, relatively few resources are devoted to controlling chronic respiratory, digestive, genitourinary or musculoskeletal diseases despite their contribution of 9% to the global burden. A review of the international health research system, with careful attention paid to the burden of disease and the current availability of cost-effective interventions, would be timely.

The burden of disease results in conjunction with information on the cost-effectiveness of health interventions should help in making international or regional resource allocation decisions. Already available information (*1*) on the burden of disease and the cost-effectiveness of interventions can identify "minimal packages" of public health and clinical interventions which, if implemented, would reduce the disease burden in low-income developing countries by about a quarter at a cost of $12 per person per year. Murray et al. have developed a computer model to define the optimal allocation of health resources, given the burden of disease, cost-effectiveness of health interventions, and the available human and physical resources in the health system (*21*). Regardless of the specific method, the burden of disease results are not the only input to a rational setting of priorities. They are, nevertheless, critical if the priorities are to be established objectively.

The results of the burden of disease exercise can be more useful at the national or subnational level. Combined with information on the global-effectiveness of health interventions, they can be used to assess objectively the allocative efficiency of the health sector and to propose the package of services that would maximize the DALYs gained, given a particular budget. The utility of this information for national health decision-makers has already been appreciated. Mexico and Mozambique began the first national burden of disease studies in early 1993. India (Andhra Pradesh), Colombia and Uzbekistan have recently initiated national or state burden of disease exercises as well. To this list must be added more than fifteen other countries that have expressed an interest in undertaking national burden of disease

analyses, including two industrialized nations. These national burden of disease exercises not only generate useful results for the health policy debate, but also indicate substantial secondary benefits, as in Mexico and Mozambique. Through the process of review, collation and estimation for each disease, the strengths and weaknesses of existing information systems are identified, and a broad network of national experts on specific health problems is created.

A strong link between national burden of disease studies and maintenance of the global and regional burden of disease estimates has emerged. Efforts at country level unearth new data and shed light on the interpretation of known information. These advances enrich the regional estimates of disability and mortality by cause. National estimates in turn would be nearly impossible without the technical backup of existing regional epidemiological profiles for each disease. When no local data are available on incidence, duration or mortality, the epidemiological relationships between key parameters captured by disease experts can form the basis of a country estimate. In addition, the network of experts created by the study has been used to provide prompt answers to specific technical questions, such as the interaction between tuberculosis and HIV-2 infection in Mozambique.

Agenda for the future

Progress on the measurement of national, regional and global burdens of disease will require methodological advance on several topics which are briefly outlined below.

(1) The list of diseases included in burden of disease exercises needs to be improved and expanded. In particular, cardiovascular diseases and neuropsychiatric disorders are very heterogeneous groups with large shares in the total burden. More detailed disaggregations are required to clarify the debate on the application of specific interventions. In addition, diseases such as appendicitis, hernia and cysticercosis need to be added because they are locally important or alternatively consume a large share of health care resources.

(2) The measurement of the time lived with disabilities of different severities needs to be improved and validated. Methods to adjust the results for both independent and dependent comorbidity should be elaborated in the context of a full partitioning of the burden of disease by consequences as illustrated in Fig. 1. Prospective studies on the distribution of disabling sequelae due to particular diseases are also needed. Finally, the global or national burden of disease results should be validated through cross-sectional household surveys.

(3) Authors of conceptual frameworks about the nature and consequences of ill-health (e.g., *22–24*) have repeatedly argued for the major role of individual behaviours and environmental factors in the causation of disease and injury. Assessing burden on the basis of medical diagnosis or disease nomenclature is thus only part of the information requirement of health planners. For a wide variety of conditions, certain behaviours or exposures have been repeatedly found to cause or contribute to disease or injury. Among the most important of these, at least in specific regions, are tobacco, alcohol abuse, poor diet, environmental degradation of various forms, malnutrition, sexual activity, certain occupations, and physical inactivity. Future work on extending the burden of disease approach to assess the contribution from these and other causes of disease and injury is urgently required to inform health policy-makers and assist in priority setting; this would involve a partitioning of the disease burden by risk factor (Fig. 1), an effort undertaken in the *World development report 1993* (*1*) for selected risk factors (nutritional, smoking and environmental). However, the analysis has not taken into account the fact that many diseases are themselves risk factors for other diseases in the sense that they increase the risk of related conditions. Diabetics, for example, have an increased risk of death and disability from cardiovascular diseases (*25*) and hepatitis B infection greatly increases the risk of dying from liver cancer (*26*). Estimates of the fractions of the burden of a specific disease that are more appropriately attributable to other conditions will also need to be developed if the approach is to reflect more reliably the impact of diseases in causing ill health.

(4) In the face of the HIV epidemic and present trends in many cancers and ischaemic heart disease and considering the known effects of changing population age-structure in many regions, projections of the burden of disease for the year 2000 or 2010 would be useful for health planners. Simple linear projections will not be adequate. Projection methods that incorporate known levels and trends of major risk factors such as smoking and trends in other diseases must be developed.

(5) If information on the burden of disease contributes useful baseline data for health policy-makers, the logical next step is to assess overall health sector performance with trends in the burden of disease. The information requirements for determining real trends in the burden of disease are much more exacting than for estimating the level of burden for an *ad hoc* study. Estimates of the level can be wrong by 5–10% without affecting the interpretation of results, but changes in the burden over a 5- or 10-year period may only be of this magnitude.

Monitoring systems that generate real estimates of mortality and disability by cause are required. Testing and application of successful sample monitoring systems for mortality and disability by cause are urgent priorities if monitoring the burden is to be a more reliable approach to assessing health priorities.

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Résumé

Le poids de la morbidité dans le monde en 1990: récapitulation des résultats, analyse de la sensibilité et orientations futures

On trouvera décrit dans cet article le mécanisme utilisé pour regrouper les données existantes sur la mortalité et l'incapacité, assorti d'avis d'experts sur les séquelles incapacitantes des maladies et des traumatismes exprimées au moyen d'un indice récapitulatif unique appelé DALY (*Disability-adjusted life years*: années de vie ajustées sur l'incapacité). Les DALY mesurent, pour une année donnée et pour chaque cause, le nombre attendu d'années qui seront vécues avec une incapacité (où la gravité de l'incapacité est exprimée par les experts par un coefficient), ainsi que le nombre d'années de vie perdues par décès prématuré. Cet indice fournit donc une statistique globale et comparée du poids de la morbidité qui découle des cas incidents de maladie et de traumatisme survenus en 1990. On trouvera indiquée la valeur des DALY par âge (0–4, 5–14, 15–44, 45–59 et ≥60 ans), par sexe, et par région, selon les huit régions définies par la Banque mondiale.

Le calcul des DALY tient compte d'hypothèses supplémentaires concernant la préférence temporelle (actualisation) et la valeur des années de vie en fonction de l'âge (poids de l'âge). Les résultats obtenus en faisant varier ces paramètres à partir des valeurs choisies dans l'étude du poids de la morbidité dans le monde sont également indiqués. Cette analyse de la sensibilité montre que les résultats de l'étude sont remarquablement stables en dépit des variations des hypothèses concernant le poids de l'âge et le taux d'actualisation tant qu'il reste différent de zéro. La seule variation importante de l'estimation résulte de la fixation du taux d'actualisation soit à zéro, valeur utilisée traditionnellement en santé publique, soit à une autre valeur que zéro.

Près de 90% du nombre total des DALY estimées pour l'ensemble du monde en 1990 (1,36 milliard) concernent les pays en développement, dont 22% pour l'Inde et autant pour l'Afrique subsaharienne. Le taux de DALY est maximal en Afrique (580 pour 1000 habitants), l'Inde (340 pour 1000) venant ensuite. Les taux estimés les plus bas correspondent aux économies de marché bien établies (EMBE) (pays industrialisés, avec 110 pour 1000). Les variations régionales des taux de DALY sont pour la plus grande part dues aux différences de mortalité prématurée. Dans l'ensemble du monde, les hommes comptent un peu plus de DALY que les femmes (52% contre 48%), avec des variations régionales faibles. Toutefois, la contribution par âge des DALY varie considérablement d'une région à l'autre, les personnes âgées (60 ans et plus) représentant 42% des DALY dans les pays industrialisés (contre 9% dans la tranche d'âge 0–4 ans), tandis qu'à l'autre extrémité, en Afrique subsaharienne, 14% seulement des DALY sont attribuables à des maladies et des traumatismes chez les personnes âgées; près de 40% des DALY sont retrouvées dans la tranche d'âge 0–4 ans. Dans toutes les régions et pour les deux sexes, la morbidité et la mortalité chez le jeune adulte (15–44 ans) occupent une place importante de l'ensemble des DALY, représentant ordinairement 15 à 20% du poids total de la maladie.

L'article conclut en mentionnant une série de questions qui exigent un développement ultérieur pour renforcer la valeur de cette méthode utilisant le poids de la morbidité comme élément clé des systèmes d'information sanitaire. D'autres recherches sont nécessaires sur la dynamique des causes majeures entrant dans ce poids telles que les maladies cardio-vasculaires, les troubles neuropsychiatriques et les traumatismes, au niveau de la population. Il est urgent de procéder à des études prospectives de la distribution et de la fréquence des séquelles incapacitantes de maladies et de traumatismes et d'établir des projections du poids de la maladie. Il est également important de disposer de méthodes d'évaluation du poids de la maladie et des traumatismes attribuables au mode de vie et à d'autres déterminants de la santé si l'on veut pouvoir utiliser réellement cette approche comme un outil nouveau, global et efficace, pour orienter les politiques et les stratégies sanitaires.

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Annex

Annex Table 1. **Total DALYs for major cause groups, by sex and age, 1990: Developed regions**[a, b]

	Males in age group (years):						Females in age group (years):						Both sexes
	0-4	5-14	15-44	45-59	60+	All ages	0-4	5-14	15-44	45-59	60+	All ages	
All Causes	6,441	2,313	27,456	20,687	28,578	85,475	5,154	1,620	17,569	12,085	29,794	66,223	151,698
I. Communicable, maternal & perinatal	2,953	172	2,215	570	770	6,680	2,226	161	3,985	301	775	7,448	14,128
A. Infectious & parasitic	342	82	1,690	305	206	2,624	264	76	2,499	114	179	3,133	5,757
B. Respiratory infections	629	89	524	265	564	2,071	516	84	458	177	596	1,831	3,902
C. Maternal conditions	-	-	-	-	-	-	-	-	1,027	10	-	1,037	1,037
D. Perinatal conditions	1,983	1	-	-	-	1,985	1,446	-	-	-	-	1,447	3,432
II. Noncommunicable	2,836	1,284	14,681	17,916	26,638	63,355	2,474	1,061	11,113	11,082	27,753	53,483	116,838
A. Malignant neoplasms	115	229	2,257	5,423	7,026	15,050	91	172	2,096	3,806	5,470	11,635	26,684
B. Other neoplasm	11	14	57	54	67	204	10	11	47	46	68	182	386
C. Diabetes mellitus	-	1	190	283	316	792	1	3	161	284	498	947	1,739
D. Nutritional/endocrine	266	152	215	151	202	987	243	139	412	149	254	1,198	2,185
E. Neuro-psychiatric	196	451	5,675	2,427	2,600	11,349	153	356	3,725	1,459	3,268	8,961	20,311
F. Sense organ	6	-	2	18	26	52	5	-	-	35	49	90	142
G. Cardiovascular diseases	117	56	2,978	5,986	12,071	21,207	98	46	1,083	2,529	14,155	17,911	39,118
H. Chronic respiratory diseases	82	176	634	731	1,814	3,437	61	141	515	387	1,167	2,270	5,708
I. Diseases of the digestive system	109	27	1,092	1,367	1,243	3,837	72	22	472	628	1,156	2,350	6,187
J. Diseases of the genito-urinary system	22	12	234	414	703	1,385	15	11	172	204	609	1,010	2,395
K. Skin disease	2	-	10	7	14	34	2	-	9	7	26	44	78
L. Diseases of the musculo-skeletal system	3	82	665	631	348	1,729	2	75	1,770	1,050	692	3,590	5,319
M. Congenital abnormalities	1,892	57	98	16	9	2,072	1,709	53	69	16	11	1,858	3,930
N. Oral health	12	25	572	405	189	1,203	12	31	582	481	314	1,420	2,623
III. Injuries	652	856	10,561	2,201	1,170	15,440	454	398	2,471	702	1,266	5,292	20,732
A. Unintentional	594	769	6,673	1,476	933	10,445	399	346	1,494	435	1,125	3,799	14,244
B. Intentional	58	87	3,888	725	237	4,995	55	52	978	267	142	1,493	6,488
Top three causes in each age group (as percentage):													
STDs excluding HIV infection	0.01	0.01	0.09	-	-	0.04	-	0.07	11.59	0.06	0.01	3.09	1.37
Acute lower respiratory infections	6.07	2.10	1.29	1.07	1.84	1.81	5.70	2.78	1.51	1.09	1.82	1.93	1.86
Otitis media	3.62	-	-	-	-	0.27	4.25	-	-	-	-	0.33	0.30
Trachea/bronchus/lung	0.01	0.04	0.97	7.17	6.35	4.17	-	0.05	0.56	3.02	1.96	1.58	3.04
Breast	-	-	-	-	-	-	-	-	2.73	7.20	2.46	3.14	1.37
Protein-energy malnutrition	2.67	-	-	0.01	0.02	0.21	3.21	-	-	0.01	0.04	0.27	0.24
Major affective disorder	-	-	2.94	0.79	0.22	1.21	-	-	9.46	3.00	0.64	3.34	2.14
Epilepsy	1.04	9.64	0.92	0.32	0.11	0.75	0.89	9.39	0.93	0.38	0.10	0.66	0.71
Alcohol dependence	-	-	8.12	6.28	1.95	4.78	-	-	1.85	1.64	0.29	0.92	3.10
Alzheimer and other dementias	0.29	0.39	0.10	2.38	5.72	2.55	0.34	0.37	0.10	4.55	8.72	4.81	3.54
Ischaemic heart disease	0.03	0.05	4.42	15.44	20.15	11.90	0.02	0.03	1.09	7.25	20.41	10.80	11.42
Cerebrovascular disease	0.21	0.52	1.82	5.35	10.01	5.26	0.21	0.60	1.71	6.34	14.51	8.17	6.53
Asthma	0.38	6.92	1.46	0.74	0.33	0.98	0.37	8.11	2.24	1.33	0.46	1.27	1.11
Rheumatoid arthritis	-	-	0.49	0.90	0.27	0.47	-	1.85	5.92	2.55	0.55	2.33	1.28
Motor vehicle accidents	1.29	12.49	11.59	1.98	0.55	4.82	1.09	9.51	5.00	1.32	0.34	2.03	3.60
Homicide and violence	0.90	2.41	7.30	1.01	0.15	2.77	1.08	2.71	3.02	0.70	0.11	1.13	2.05

[a] DALYs are in thousands.

[b] A dash represents less than a thousand DALYs or less than 0.01%.

Annex Table 2. **Total DALYs for major cause groups, by sex and age, 1990: Developing regions**[a, b]

	Males in age group (years):						Females in age group (years):						Both sexes
	0-4	5-14	15-44	45-59	60+	All ages	0-4	5-14	15-44	45-59	60+	All ages	
All Causes	266,770	75,161	159,317	63,478	63,204	627,931	249,637	66,642	157,081	48,273	60,541	582,174	1,210,105
I. Communicable, maternal & perinatal	199,740	39,276	44,695	9,742	5,997	299,450	183,358	38,298	77,895	6,519	5,053	311,122	610,572
A. Infectious & parasitic	99,461	34,104	40,835	8,761	3,455	186,616	94,065	32,551	46,030	5,240	2,281	180,166	366,782
B. Respiratory infections	47,082	5,170	3,860	981	2,542	59,635	46,267	5,290	3,912	1,012	2,772	59,253	118,888
C. Maternal conditions	-	-	-	-	-	-	-	457	27,952	267	-	28,676	28,676
D. Perinatal conditions	53,197	1	-	-	-	53,199	43,026	-	-	-	-	43,027	96,226
II. Noncommunicable	52,351	20,292	59,460	47,834	54,724	234,660	52,059	18,631	59,875	39,169	53,209	222,943	457,604
A. Malignant neoplasms	727	2,545	6,873	10,353	9,152	29,651	1,294	723	7,024	8,341	6,297	23,679	53,330
B. Other neoplasm	94	167	236	145	88	729	151	1,189	297	108	89	1,835	2,564
C. Diabetes mellitus	10	6	701	1,036	927	2,680	11	19	680	1,372	1,466	3,548	6,228
D. Nutritional/endocrine	16,219	1,668	5,665	918	560	25,030	16,169	2,190	5,574	1,195	840	25,969	50,999
E. Neuro-psychiatric	2,773	6,904	19,167	5,488	4,456	38,787	2,673	5,078	18,464	3,398	4,058	33,671	72,458
F. Sense organ	269	40	325	1,946	1,291	3,871	249	74	373	2,277	1,256	4,228	8,098
G. Cardiovascular diseases	2,891	1,691	10,354	15,418	24,822	55,176	2,486	2,524	9,348	12,493	26,775	53,625	108,802
H. Chronic respiratory diseases	4,931	3,042	3,621	2,906	7,393	21,893	5,055	2,127	3,599	2,691	6,334	19,805	41,698
I. Diseases of the digestive system	5,630	1,372	6,325	4,679	3,044	21,049	6,934	1,734	4,226	2,877	2,325	18,095	39,145
J. Diseases of the genito-urinary system	672	1,503	1,797	2,727	1,507	8,207	419	1,254	2,266	1,557	1,512	7,008	15,215
K. Skin disease	116	57	44	23	56	296	119	26	209	17	98	468	764
L. Diseases of the musculo-skeletal system	25	273	1,724	1,336	751	4,110	79	661	4,994	1,928	1,399	9,061	13,171
M. Congenital abnormalities	17,797	765	503	17	10	19,092	16,232	770	774	55	6	17,837	36,929
N. Oral health	193	255	2,119	835	652	4,054	186	245	2,037	855	733	4,056	8,110
III. Injuries	14,679	15,593	55,162	5,902	2,584	93,821	14,220	9,714	19,312	2,585	2,278	48,109	141,930
A. Unintentional	12,440	13,609	32,653	4,153	1,923	64,777	11,621	8,406	10,027	1,664	1,824	22,541	93,318
B. Intentional	2,239	1,985	22,509	1,749	561	29,044	2,599	1,308	9,285	921	454	14,568	43,612
Top three causes in each age group (as percentage):													
Tuberculosis	0.46	4.12	8.27	9.48	4.02	4.15	0.53	5.69	6.92	5.72	1.87	3.42	3.80
STDs excluding HIV infection	0.51	0.03	1.47	0.17	0.01	0.61	0.49	0.06	8.76	0.26	0.02	2.61	1.57
HIV	0.50	0.07	9.25	0.65	0.03	2.64	0.49	0.34	6.55	0.32	-	2.05	2.35
Diarrhoeal diseases	15.77	6.08	1.68	0.65	0.36	7.95	16.28	7.11	1.71	0.88	0.38	8.37	8.15
Childhood cluster	10.66	8.09	0.10	0.09	0.04	5.54	10.70	8.60	0.11	0.13	0.05	5.62	5.58
Intestinal helminths	0.02	11.43	0.30	0.06	0.04	1.46	0.02	12.34	0.29	0.08	0.04	1.51	1.48
Acute lower respiratory infections	16.73	6.50	2.02	1.38	3.93	8.93	17.57	7.54	2.12	1.90	4.48	9.59	9.25
Ischaemic heart disease	0.03	0.07	1.51	7.71	11.67	2.36	0.01	0.04	0.64	4.83	11.48	1.78	2.08
Cerebrovascular disease	0.11	0.41	1.37	6.83	13.74	2.52	0.09	0.60	1.52	8.94	16.40	2.97	2.73
Chronic obstructive lung disease	0.14	0.18	0.25	2.77	9.57	1.39	0.12	0.14	0.25	2.91	8.03	1.21	1.30
Motor vehicle accidents	0.45	4.45	8.12	1.86	0.55	3.03	0,37	3.69	2.11	0.88	0.26	1.25	2.17

[a] DALYs are in thousands.

[b] A dash represents less than a thousand DALYs or less than 0.01%.

Annex Table 3. **Total DALYs for major cause groups, by sex and age, 1990: All regions**[a, b]

	Males in age group (years):						Females in age group (years):						Both sexes
	0-4	5-14	15-44	45-59	60+	All ages	0-4	5-14	15-44	45-59	60+	All ages	
All Causes	73,211	77,474	186,774	84,165	91,782	713,406	254,791	68,262	174,650	60,359	90,335	648,397	1,361,803
I. Communicable, maternal & perinatal	202,693	39,448	46,910	10,312	6,767	306,130	185,584	38,458	81,879	6,820	5,828	318,570	624,700
A. Infectious & parasitic	99,802	34,186	42,525	9,066	3,661	189,241	94,328	32,627	48,529	5,354	2,461	183,299	372,539
B. Respiratory infections	47,711	5,259	4,384	1,246	3,106	61,706	46,783	5,374	4,370	1,189	3,368	61,084	122,790
C. Maternal conditions	-	-	-	-	-	-	-	457	28,980	277	-	29,713	29,713
D. Perinatal conditions	55,180	2	-	-	-	55,183	44,472	1	-	-	-	44,474	99,658
II. Noncommunicable	55,187	21,576	74,141	65,750	81,362	298,016	54,533	19,692	70,988	50,252	80,962	276,426	574,442
A. Malignant neoplasms	843	2,774	9,130	15,777	16,178	44,701	1,385	895	9,119	12,148	11,767	35,314	80,015
B. Other neoplasm	105	181	293	199	155	933	161	1,200	345	153	157	2,017	2,950
C. Diabetes mellitus	11	7	891	1,319	1,243	3,473	12	22	841	1,656	1,964	4,495	7,968
D. Nutritional/endocrine	16,484	1,820	5,880	1,069	762	26,017	16,412	2,329	5,986	1,345	1,094	27,167	53,183
E. Neuro-psychiatric	2,969	7,355	24,842	7,915	7,056	50,137	2,826	5,434	22,189	4,857	7,326	42,632	92,768
F. Sense organ	276	40	327	1,963	1,316	3,923	253	74	374	2,311	1,305	4,318	8,240
G. Cardiovascular diseases	3,008	1,748	13,332	41,403	36,893	76,384	2,584	2,569	10,431	15,022	40,930	71,356	147,920
H. Chronic respiratory diseases	5,014	3,218	4,255	3,637	9,207	25,331	5,115	2,267	4,114	3,078	7,501	22,075	47,406
I. Diseases of the digestive system	5,739	1,399	7,417	6,046	4,286	24,887	7,006	1,756	4,697	3,505	3,481	20,445	45,332
J. Diseases of the genito-urinary system	694	1,515	2,032	3,141	2,210	9,562	434	1,265	2,437	1,761	2,122	8,018	17,610
K. Skin disease	119	58	54	30	69	330	121	26	218	23	124	512	842
L. Diseases of the musculo-skeletal system	28	355	2,389	1,968	1,099	5,839	81	736	6,763	2,979	2,092	12,651	18,490
M. Congenital abnormalities	19,689	822	601	32	19	21,164	17,941	823	843	72	17	19,695	40,859
N. Oral health	205	281	2,691	1,240	841	5,257	197	276	2,620	1,336	1,046	5,476	10,733
III. Injuries	15,331	16,450	65,273	8,103	3,654	109,261	14,674	10,112	21,783	3,287	3,545	53,401	162,662
A. Unintentional	13,034	14,377	39,326	5,629	2,856	75,222	12,020	8,752	11,521	2,099	2,949	37,340	112,562
B. Intentional	2,297	2,072	26,397	2,474	798	34,039	2,655	1,360	10,263	1,188	596	16,061	50,100
Top three causes in each age group (as percentage):													
Tuberculosis	0.45	4.00	7.15	7.31	2.86	3.71	0.52	5.56	6.24	4.62	1.29	3.08	3.41
STDs excluding HIV infection	0.49	0.03	1.27	0.13	0.01	0.54	0.48	0.06	9.05	0.22	0.02	2.66	1.55
HIV	0.50	0.07	8.55	0.62	0.03	2.51	0.50	0.34	6.07	0.28	-	1.89	2.22
Diarrhoeal diseases	15.43	5.93	1.48	0.52	0.27	7.03	15.98	6.97	1.59	0.74	0.28	7.55	7.28
Childhood cluster	10.42	7.89	0.08	0.07	0.03	4.88	10.49	8.44	0.10	0.11	0.03	5.05	4.96
Intestinal helminths	0.01	11.09	0.26	0.05	0.03	1.29	0.02	12.05	0.26	0.07	0.03	1.36	1.32
Acute lower respiratory infections	16.47	6.37	1.92	1.31	3.28	8.08	17.33	7.42	2.06	1.74	3.60	8.81	8.43
Major affective disorder	-	-	2.87	0.85	0.23	0.88	-	-	6.14	2.42	0.57	1.96	1.39
Ischaemic heart disease	0.03	0.07	1.94	9.61	14.31	3.50	0.01	0.04	0.68	5.31	14.43	2.70	3.12
Cerebrovascular disease	0.12	0.41	1.44	6.47	12.58	2.85	0.09	0.60	1.54	8.42	15.78	3.50	3.16
Chronic obstructive lung disease	0.14	0.18	0.23	2.49	7.99	1.46	0.12	0.14	0.24	2.56	6.17	1.22	1.35
Motor vehicle accidents	0.47	4.69	8.63	1.89	0.55	3.24	0.38	3.82	2.40	0.97	0.29	1.33	2.33

[a] DALYs are in thousands.

[b] A dash represents less than a thousand DALYs or less than 0.01%.